Pertanika J. Trop. Agric. Sci. 25(1): 47 - 51 (2002)

ISSN: 1511-3701

The Removal and Burning of Pineapple Residue in Pineapple Cultivation on Tropical Peat: An Economic Viability Comparison

*O.H. AHMED, M.H.A. HUSNI, A.G. AWANG NOOR[1] & M.M. HANAFI

Department of Land Management, Faculty of Agriculture,
Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia
**E-mail: osman60@hotmail.com*
[1]Faculty of Forestry, Universiti Putra Malaysia,
43400 UPM Serdang, Selangor, Malaysia

Keywords: Pineapple residues, economic viability, open burning, tropical peat

ABSTRAK

Kajian dijalankan bertujuan membanding kebaikan kesan serta kos pembakaran 'in situ' sisa nanas dan pembuangan sisa nanas dari ladang sebelum penanaman semula, ke atas pertumbuhan nanas di tanah gambut tropika. Rawatan yang digunakan adalah: (i) sisa (daun, 'crowns', dan 'peduncles') dikeluarkan dari ladang diikuti dengan pembajaan (RRF), dan (ii) sisa (daun, 'crowns', dan 'peduncles') dibakar diikuti pembajaan (amalan biasa) (RBF). Di akhir kajian, berat purata buah untuk setiap rawatan ditentukan. Berat ini kemudiannya didarabkan dengan kepadatan pokok iaitu 56,250 untuk mendapatkan hasil dalam 1 hektar. Hasil didarab jumlah hasil/ha dengan harga jual ladang akan memberi jumlah pulangan kasar pengeluaran tanaman ini. Kos pekerja pula telah ditentukan berasaskan sistem gaji yang diamalkan di ladang nanas. Harga pasaran ladang digunakan sebagai kayu pengukur kos bahan penanaman serta lain-lain bahan. Kos tanah pula dikira berasaskan sewa tahunan ladang nanas. Semua pengiraan kos tertakluk pada 12% kadar faedah harga kapita. Di bawah Akta Kualiti Alam Sekitar 1978 pindaan 1998 dan Indeks Pencemaran Udara (API) pencemar akan dikenakan denda atas perlakuan pembakaran secara terbuka yang mengakibatkan pencemaran udara. Kesemua ini akan diambil kira semasa membuat penganggaran kos penanaman nanas. Pembakaran sisa tidak meningkatkan hasil secara bererti. Analisis ke atas kos telah membuktikan perolehan keuntungan menerusi pengeluaran sisa nanas (RRF) berbanding pembakarannya. Penerimaan konsep RRF memerlukan kajian yang lebih mendalam tentang cara sesuai yang boleh digunakan untuk meningkatkan kualiti atau menghasilkan sisa produk yang tinggi nilai komersialnya. Kos kajian ini harus ditanggung bersama oleh pihak kerajaan, ladang-ladang nanas serta orang ramai.

ABSTRACT

The study was conducted to compare the benefits and costs of in situ burning of pineapple residues with removal of pineapple residues (before replanting) in pineapple cultivation on tropical peat. Treatments used were: (i) residues (leaves, crowns, and peduncles) removal followed by fertilization (RRF) and (ii) residues (leaves, crowns, and peduncles) burnt followed by fertilization (usual practice) (RBF). At the end of the study, the average fruit weight per treatment was recorded. Fruit weight multiplied by the plant density of 56,250 will give the total yield per hectare. The product of the total yield/ha and farm-gate price will give the gross revenue of crop production. Cost of labour was based on the wage system practiced by the pineapple estates. Farm-gate market prices were used for assessing farm materials and other inputs. Cost of land was based on the annual rental value for pineapple plantations. An interest rate of 12% was charged on the capital used. Under the Environmental Quality Act, 1978 amended in 1998, and according to the Air Pollutant Index (API) the polluters have to pay the principal fine imposed for polluting the air through open burning of pineapple residues. All these costs will be taken into account when calculating the production cost of pineapple. Burning did not significantly increase yield. Cost and benefit analysis revealed that removal of pineapple residues (RRF) is more economically viable than burning the residues (RBF). Adoption of RRF requires further studies in selecting the most suitable method of enhancing the quality of the environment or developing product(s) of commercial value from pineapple residues. The cost of the study should be borne partly by the government, the pineapple estates, and the public.

INTRODUCTION

Pineapple (*Ananas comosus*) is generally grown on mineral soils (Py *et al.* 1987). On these soils, pineapple residues are usually shredded or ploughed back into the soil after cropping or before replanting. In Malaysia, the crop is largely (17,000 ha) and uniquely cultivated on peat (AGRIQUEST 1999/2000). This practice has been in existence for nearly a century (Selamat and Ramlah 1993). The inherent nature of peat does not allow shredding or ploughing of these residues into the soil before replanting. This, coupled with the lack of an effective and efficient mode of handling pineapple residues often result in the residues being recycled through open burning. The practice is also known to reduce the incidence of disease and pest outbreaks (Jordan 1985), as well as labour costs (land preparation).

Despite these benefits, the environmentally damaging effects of open burning on the environment need to be addressed seriously. The ripplling effects of the 1997/98 haze across South East Asia are still fresh in most people's memories and have left an indelible mark in the minds of the inhabitants of this region and the world at large. Currently, open burning of most crop residues including pineapple has been outlawed (Environmental Quality Regulations 1974 amended in 1998). Non- conformity to this ruling will incur a penalty of RM 100,000.00. This new regulation has put the entire pineapple industry at a crucial crossroad. The closest alternative to the burning of pineapple residues is the in situ decomposition of the residues. However, the building or piling up of the partially decomposed residues with time is envisaged or inevitable since it takes not less 13 months or more before the decomposition of these residues. Besides, with the addition of partially decomposed organic matter to the already existing one, a prolonged adoption of any of the practices mentioned without proper handling of the residues may not only lead to the outbreak of fire, disease, and pests but also, the likelihood of inefficient fertilization because of the massive accumulation of these residues on the soil surface.

One of the possible ways to handle or manage pineapple residues without jeopardizing or sacrificing the quality of the environment is to remove the residues or convert these residues into value added products of commercial potential. An innovative or noble approach along this line will not only help generate additional income to offset or defray some of the accompanying costs of removing pineapple residues from the field before replanting but also create job opportunities. However, before embarking on such an idea, it is only befitting that a study be conducted to compare the yield as well as the economic viability of removing pineapple residue with that of the open burning of these residues (usual practice).

The objective of the study therefore was to compare the benefits and costs of in situ burning of pineapple residues with that of removal of pineapple residues in pineapple cultivation on tropical peat.

MATERIALS AND METHODS

The study was conducted at Simpang Rengam Pineapple Estate, Simpang Rengam, Johore with the treatments: (i) residues (leaves, crowns, and peduncles) removed followed by fertilization (RRF) and (ii) residues (leaves, crowns, and peduncles) burnt followed by fertilization (usual practice) (RBF). The experimental unit was the individual plants planted in a 4 m x 12 m plot. A total of 300 suckers (Gandul; most commonly grown variety) were planted in each plot. The experimental plot was a randomized complete block design (RCBD) with four replications.

At the end of the maturity period (2 years), the average fruit weight for each treatment was determined from a total of 100 fruits. Fruit weight was multiplied by plant density of 62,500 less 10% (56,250) to calculate the total yield per hectare. The adjusted factor of 10% was taken into account because of the possible mortality of some of the plants before harvest.

The product of the total yield per hectare and farm-gate price gave the gross revenue of crop production. In this study, the farm-gate price was used in all the analyses.

The cost of labour was based on the wage system as practiced by the estate. The farm-gate price was used to accommodate cost of all farm materials and other inputs. The cost of land was calculated based on the annual rental value for pineapple plantations. An interest rate of 12% on the capital cost was adopted. Fines imposed on polluters (OECD 1975) were calculated in accordance with the Malaysian Environmental Quality Act, 1978 (amended in 1998) on burning of waste and the Air Pollutant Index (API).

From the API categorization (DOE 1996) (Table 1) the maximum fine of RM 100,000.00 (Environmental Quality Act 1978,) for open burning was apportioned as follows:

TABLE 1
API category of fines

API	Category	RM
0 - 50	Good	10,000.00
51 - 100	Moderate	15,000.00
101 - 200	Unhealthy	30,000.00
201 - 300	Very Unhealthy	50,000.00
301 - 500	Hazardous	75,000.00
> 500	Dangerous	100,000.00

The moderate category which corresponds to the RM 15,000.00 was used to calculate the cost of pollution per ha. This figure was arrived at by dividing RM 15,000.00 by 7.87 ha. The "moderate" category was selected based on the fact that since the much practiced open burning has been going on for more than 30 years, suspension of some air pollutants in the atmosphere due to burning was not ruled out and hence the category "good" was not applicable. Similarly, as burning is carefully regulated by the estate and complaints are yet to be lodged, neither of the categories succeeding "moderate" was deemed appropriate. The Land Expectation Value (LEV) was used to compare the viability of the two practices. The economic value of residue management is estimated based on "with" (RRF) and "without" (RBF) project frameworks. Using this approach, the economic cost of environmental pollution can be evaluated based on the incremental net benefit, calculated as the difference between net benefits of RRF and RBF practices.

The current practice of residue management is through open burning of leaves, crowns, and peduncles. The other alternative open to plantation owners is to invest in the removal of crop residue (RRF). This is costly, and will therefore affect the profitability of the pineapple farming system over time. Thus, the cost is measured in terms of the loss in the long-run net profitability of the plantation farming system for not investing in the removal of the crop residues. That is, the cost of the environmental pollution is the difference between the (present value) net returns of the pineapple plantation with RRF and the (present value) net returns with RBF practices. The relationship is clearly shown by the following formula: $INB = NB^{RRF} - NB^{RBF}$, where INB = Incremental net benefit (present value), NB^{RRF} = Net benefit of RRF practice (present value), and NB^{RBF} = Net benefit of burnt practices (present value).

The assumption made is that a pineapple plantation is managed based on a sustainable yield basis. Such an assumption enables the calculation of the incremental net benefit using the Land Expectation Value (LEV) framework (Klemperer 1996).

The land expectation value is written as:

$$LEV = \frac{INBt}{(1 + i)^t - 1}$$

where INB = Incremental net benefit at end of pineapple rotation (2 years), t = length of pineapple rotation (2 years), and i = rate of interest.

RESULTS AND DISCUSSION

The estimated yields from RBF and RRF were 56.81 and 56.25 Mg/ha, respectively. The difference of 0.56 Mg/ha was not statistically significant at P (0.05) using the t-test. The corresponding gross revenue of the pineapple production (benefit) of LRBF and RRF amounted to RM 9,090.00 and RM 9,000.00, respectively (Table 2).

The difference in the RBF and RRF management practices is demonstrated in the costs of labour, pollution, and yield (Table 2). The cost of farm materials, maintenance, and land were similar for both practices (Table 2).

The overall costs of labour of the RBF and RRF practices were estimated at RM 2248.15 and RM 2,422.78, respectively. The difference of RM 174.63 was due to the different methods employed during land preparation. During this phase, about RM 218.95 (9.04% of the total cost of labour for RRF) was spent on crop residue removal and transportation as against RM 44.32 (1.53% of the total cost of labour for residue burning (RBF)). Compared to the other labour-related activities (Table 2), the cost involved in crop residue burning (RBF) was among the cheapest for farm activities. Unlike RRF, labour cost was the third most expensive activity. Perhaps, this justifies the burning of pineapple residues in pineapple plantations, as the amount of RM 1,74.63 saved through this practice is approximately 94.03% higher than RM 90.00 (difference between the revenues of RRF and RBF; RM 9,090.00 - 9,000.00). The result further

TABLE 2
Present value (12% interest) of cash flow per ha basis for burning and removal of pineapple residues

Activity	Year 1	Year 2
	RM	
RBF (Burning residues)		
Inflow (Benefit)		
Yield	0	9,090.00
Outflow (Costs)		
Land preparation	44.32	0
Preparation of suckers	898.44	0
Planting	1,054.69	0
Fertilization	123.75	0
Pesticides application	39.83	0
Hormoning	42.67	0
Harvesting	0	44.45
Suckers	0	2,343.75
Fertilizer	0	1,657.78
Pesticides	0	166.28
Hormone	0	188.32
Land	42.08	0
Maintenance	181.48	0
Net Benefit		**2,262.16**
RRF (removal of residues)		
Inflow (Benefit)		
Yield	0	9,000.00
Outflow (Costs)		
Land preparation	218.95	0
Preparation of suckers	898.44	0
Planting	1,054.69	0
Fertilization	123.75	0
Pesticides application	39.83	0
Hormoning	42.67	0
Harvesting	0	44.45
Suckers	0	2,343.75
Fertilizer	0	1,657.78
Pesticides	0	166.28
Hormon	0	188.32
Land	42.08	0
Maintenance	181.48	0
Net Benefit		**1,997.47**
Incremental Net Benefit		**264.69**
* Pollution: Using fines of RM 100,000.00	2,382.47	0
Incremental Net Loss at RM 100,000.00 fine		**120.31**

RM 3.80 = 1 USD

suggests that the practice of burning crop residues may not only be essential for the avoidance of tillage related problems and practices, but also helps in the reduction of labour costs for pineapple production.

The cost of pollution at a fine of RM 100,000.00 was estimated to be RM 2,382.47. The net benefits for RBF and RRF practices were estimated at RM 2,262.16 (excluding cost of pollution) and RM 1,997.47, respectively (Table 1). If the usual burning practice of the estate is followed, the incremental net benefits of RBF practice over the RRF practice will be RM 264.69 (RM 2,262.16 - 1,997.47). This suggests that burning is feasible at 12% interest rate. However, if the environmental cost of pollution of RM 2,382.47 ha-1 is included [assuming pollution is a cost to plantation owners (Gittinger 1982)], the cost of production will increase to RM 9,210.31, with net loss of RM 120.31 (RM 9,090.00 - 9,210.31). The loss incurred with the inclusion of the pollution value further implies that no attempt should be made to adopt burning as part of the pineapple residue management.

Policy Implication

The imposition of the RM 100,000.00 fine renders the existing burning of pineapple residues as a non-viable practice, and hence demonstrates the need to resort to residue removal. The current stringent law imposed on open burning puts the present and future prospects of the entire pineapple industry at stake. In order for the pineapple industry to remain in business, it is proposed that all parties involved i.e. the government, the public and the estate owners should pool resources available to set up a common fund for research on how to develop technique(s) that will add value, or develop product(s) of commercial value from these pineapple residues. As many as 15,000 tonnes of pineapple residues are produced per cropping season and burnt openly (Ahmed *et al.* 1999). Recommendations from the respective parties will be subject to decisions of the policy makers.

CONCLUSION

Under the new ruling, removal of pineapple residues (RRF) before replanting looks economically viable. However, in order to overcome waste disposal problems, there is the need to improve the value or develop products which are commercially viable from these pineapple residues if this type of waste management is to be adopted fully by pineapple planters or growers.

ACKNOWLEDGEMENT

We thank Mr. Lee Sing Kim, Mr. Koh Soo Koon and Mr. Faisol Abdul Ghani of the Simpang Rengam Pineapple Estate for their help, the National Council for Scientific Research and Development, Malaysia for financial support and the staff of the Soil Fertility Laboratory for their analyses.

REFERENCES

AGRIQUEST SDN. BHD. 1999/2000. *Malaysia Agricultural Directory and Index.* Kuala Lumpur: AGRIQUEST Sdn. Bhd.

AHMED, O.H., M.H.A., HUSNI, R.S. SYED OMAR, M.M. HANAFI and S.K. KOH. 1999. The effects of residue management practices on phosphorus and potassium uptake in pineapple. *Malaysian Journal of Soil Science* **3**: 29-37.

DEPARTMENT OF ENVIRONMENT. 1996. *Malaysia Environmental Quality Report, 1996.* Kuala Lumpur: Department of Environment.

ENVIRONMENTAL QUALITY ACT. 1974. *Act 127 and Subsidiary Legislations.* Kuala Lumpur: International Law Book Services.

GITTINGER, J.P. 1982. *Economic Analysis of Agricultural Projects.* 2nd ed. Baltimore: John Hopkins Univ. Press.

JORDAN, C.F. 1985. *Nutrient Cycling in Tropical Forest Ecosystems.* New York: John Wiley and Sons.

KLEMPERER, W.D. 1996. *Forest Resource Economics and Finance.* New York: McGraw-Hill.

ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD). 1975. *The Polluter Pay Principle: Definition, Analysis, Implementation.* Paris: OECD Press.

PY, C., J.J. LACOEUILHE and C. TEISSEN. 1987. *The Pineapple Cultivation and Uses* (translated by Daphe and J. Goodfellow). 15 rue Victor-Cousin, Paris (ve).

SELAMAT, M.M. and M. RAMLAH. 1993. The response of pineapple cv. Gandul to nitrogen, phosphorus, and potassium on peat soils in Malaysia. *ACTA Horticulturae* **334**: 247-254.

(Received: 7 July 2000)
(Accepted: 27 February 2002)